

LERP

Linux Embedded Robotics Package

2001 [Embedded Linux Journal](#) Contest Entry

email: pstakem@loyola.edu

In the LERP project, the MZ104 will host the development environment and provide high-level guidance to an existing embedded MC6808 device controller. The Linux-based processor will run higher-order packages based on [Logo](#), Java, [Python](#), or other languages, while the 6808 board is limited to assembler or BASIC.

The starting point is a Heath Hero-Jr. robot, from the 1980's, with an embedded 6808 processor. I bought this unit new as a kit, and assembled it. The 6808 has a RS-232 interface that can be used to communicate with the outside world. Shared memory between the 6808 and another processor is also possible. The existing system has a hex keypad and display, and a voice synthesizer. The most effective method of robot-to-human communication is with the voice unit. The existing system can measure light level (8 bit), sound level (8 bit), and distance (via the Polaroid ranger). The board also controls the robot drive and steering.

The existing 6808 is a classic embedded processor with limited resources and human interface. The LERP Project is targeted to extending those resources and interfaces, and providing a development environment. Before the MZ014, various other architectures were tried. All of these suffered from excessive current draw and/or limited functionality. An IBM PS2/35 EX board drew 1.65-1.73 amps, with 4 megs of memory. A similar 386SX-40 board drew 1 amp with 4 megs of memory. (this board runs Linux quite well). A 68020 board drew about 1 amp. A 68HC11 board drew 110 mA, but had limited (8 k) ram. All in all, the MZ014 board is ideal in this application, and provides processing, storage, and I/O resources that are not limiting.

The MZ014 provides two serial interfaces, one of which is dedicated to communication with the 6808. The MZ014 also provides for a floppy, a hard drive, a cd, keyboard, mouse, and vga. The built-in USB is used in conjunction with a webcam. The other RS-232 will be used with a GPS navigation device.

The hard drive allows the MZ014 to host the development environment for the 6808. This consists of a series of 6808 software tools; an assembler, linker, and loader. The function interface allows the MZ014 to write and download programs to the 6808. The MZ014 was checked out with DOS and Windows, and with the BlueCat and ELKS Linux distributions.

Since the robot is battery powered, a custom power supply for the MZ104 was constructed. This uses a +12 volt input from the battery, and provides the necessary +12, -12 and 5 volts. Power consumption is a major issue for battery life. The MZ104 using

serial console mode draws 500-560 mA. This rises to 890 mA with the floppy in use, and 1.78 amps with the hard drive in use. While the custom power supply was installed, a special jumper connection was added, to supplement the robot's 12 volt, 4 A-H battery. This allows an external 12 volt supply (such as a jump-start unit for a car) to be used to run the robot on the bench, and charge the battery. This is in addition to the robot's small wall-mount recharger.

Testing Configuration

The 6808 processor board is connected to the MZ104 via an async serial line, using a 9600E71 protocol. When the 6808 is running its built-in BASIC interpreter (in cartridge-ROM), the MZ104 acts as a terminal, to download BASIC programs to the 6808 (the alternative being 6800 assembly language). LOGO would be a better choice, but it is not ported to the 6808. Logo can be run under Linux, on the MZ104.

The MZ014 computer is built into the base of the robot, and powered from the battery. The floppy and hard drive are included, but not normally powered. The serial console of the MZ104 is tied to a development LINUX box. This interface would best be moved to a wireless LAN 802.11 connection. An IR modem has too limited a range.

Resources

Robot Doerr's [Hero page](#)

[Hero Robot Web Source Webpages](#)